CHAPTER H

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H.00 General

This chapter covers the maintenance of bridges that are 20 feet (6.096 meters) or longer between abutments and special structures such as seal slabs and major retaining walls that are identified by assigned bridge numbers. The work performed will be under the HM3-H Family of the Maintenance Program. Work on structures less than 20 feet (6.096 meters) long, primarily large culverts, is included in the HM2 Roadside Program.

Bridge maintenance includes work such as repairing damage or deterioration in various bridge components; removing debris and drift from piers, bearing seats, abutments, etc.; cleaning out drains; repairing expansion joints; cleaning and painting structural steel; sealing concrete surfaces; etc. Also included are the maintenance of electrical and mechanical equipment on moveable span bridges and the operation of the moveable spans.

Refer to Volume 2 of the Maintenance Manual for planning, scheduling and administrative procedures connected with the HM3-H Family.

H.01 Maintenance Levels

Bridge maintenance work can be grouped into two categories: work initiated by the District and work recommended in Bridge Inspection Reports.

Work initiated by Districts is generally in response to a problem on a bridge that affects public safety or the structural integrity of the structure if not promptly attended to. Also included in this category is work to satisfy Level of Service requirements, which are detailed in Volume 2 of the Maintenance Manual.

Work recommended in bridge inspection reports, is the result of periodic engineering inspections performed by Area Bridge Maintenance Engineers (ABMEs) from the Office of Structures Maintenance and Investigations (OSM&I). This work is generally of the nature that can be accomplished on a planned basis. However, when the work is of a critical nature, the ABME will immediately contact the District and verbally transmit instructions regarding the work required. This will be followed by a Bridge Inspection Report covering the work recommended.

Repair recommendations, methods, and procedures for major defects, shall be closely adhered to.

Because structural considerations are involved, no changes or deviations shall be made without the concurrence of the ABME. Descriptions of major or minor defects are listed in following sections of this chapter.

H.02 Inspections by Area Bridge Maintenance Engineers

To comply with federal regulations, all bridges over 20 feet (6.096 meters) long shall be inspected by qualified bridge maintenance engineers at a maximum interval of two years, and more frequently if conditions require a more frequent inspection. As part of the inspection, an engineering evaluation is made of the condition of all structural components and recommendations are made for any work necessary.

A copy of the Bridge Inspection Report is forwarded to the District Division Chief of Maintenance and Operations, who is responsible for scheduling and accomplishing the work recommendation in a timely manner.

Each work recommendation is identified by a 12-digit code and accompanied by an estimated cost to do the work. A computer listing of all work recommendations not accomplished to date is sent monthly to the Districts by OSM&I. As the work is completed, the District is to report its completion by lining out the item on the computer listing or writing "Completed" on the Bridge Inspection Report and returning the listing or the report to OSM&I. A quarterly summary of the amount of work outstanding is sent by OSM&I to each District.

Bridge Reports frequently contain recommendations that the work be done by contract.

However, the districts may elect to do the work with their own forces, provided that the work is within statutory and policy limitations on work by maintenance forces.

When work is to be done by contract, OSM&I will prepare the PS&E, except for traffic handling, upon the issuance of an expenditure authorization by the Districts. Scheduling of projects will be a joint effort between OSM&I and the Districts.

H.03 Inspections by District Maintenance Supervisors

Periodic walk through inspections shall be made by District Maintenance Supervisors to detect obvious defects, hazards or potential problems and also to monitor known problems. Refer to the Level of Service section of Volume II of the Maintenance Manual for frequency of these inspections. The purpose of this inspection is to supplement the more detailed, but less frequent, inspections by the ABME. Special attention should be given to steel bridges where cracks have a greater impact on structural safety than on concrete bridges.

When major defects or hazards are found, they shall be immediately reported to OSM&I by telephone. If an emergency condition exists, appropriate action shall be taken as soon as possible to ensure the safety of the traveling public and to prevent further structural damage from occurring. This includes restricting traffic on the bridge or closing it completely, installing temporary support systems, making temporary repairs, etc. OSM&I will immediately send out an ABME to evaluate the condition of the structure and direct necessary repairs.

After a major storm, earthquake or other natural event that may have caused damage to bridges, Area Supervisors should inspect all bridges in the affected area for signs of damage. Any damage found should be reported to OSM&I.

Structures less than 20 feet (6.096 meters) long are not inspected by OSM&I. These structures are generally the larger culverts and other minor structures. These structures should also receive periodic walk through inspections. See Chapter C5 of this Manual for instructions regarding inspection of these structures. Also see the Caltrans Storm Water Quality Handbook-Maintenance Staff Guide.

H.04 Movable Span Bridges - Inspection and Testing

The mechanical and electrical equipment of movable span bridges will be inspected once a year by qualified mechanical and electrical engineers from the OSM&I. For bridges that are not open regularly for waterway traffic, the spans should be opened at intervals frequent enough to ensure that all mechanical and electrical equipment, are functional. Diesel or gasoline powered engines should be operated at least once every 2 weeks.

H.05 Definitions

The OSM&I assigns an official bridge number and name to all "Bridges" meeting the following criteria:

(A) All structures which, measured parallel to the roadway centerline, have a length of more than 20 feet (6.096 meters) between the inside faces of the end abutments shall be carried as bridges regardless of the length of the spans making up this total.

(B) In addition, bridge numbers may be assigned to other structures where periodic inspections with written reports are desired. This includes such structures as very large retaining walls, mechanically stabilized earth walls, seal slabs, specially designated culverts, and other unique structures.

(C) The name assigned to each structure given a bridge number has an association with its function as a highway facility. Name types are defined below.

(1) Bridge

This term is used in a name when the function of the structure is to carry traffic over a watercourse such as a bay, canyon, river, creek, wash or slough.

(2) Overhead

This term is used in a name when the function of the structure is to carry a State highway over a railroad.

(3) Underpass

This term is used in a name when the function of the structure is to carry a railroad and provides for passage of a State highway under the railroad.

(4) Overcrossing

This term is used in the name of a structure which carries State highway traffic and provides for passage of a city street, county road or other facility other than a railroad or another State highway, under the State highway.

(5) Separation

This term is used in the name of a structure, which carries traffic of one State highway over another State highway.

(6) Viaduct

This term is used in the name of a structure of any length, which carries State highway traffic along a steep side hill. It also is used as a compromise name for a long structure crossing over several facilities of approximately the same importance, any one of which alone would require a name category of Bridge, Overhead, Undercrossing, or Separation.

(7) Tunnel

This term refers to a roadway section through a mass of earth. Some undercrossings and separations are also tunnels.

(8) Tube

This term describes an underwater roadway facility constructed by lowering a prefabricated section in an excavated trench.

(9) Pumping Plant

This term is used in the name of a facility that is assigned a bridge number because it is an intricate facility of structural, mechanical, and electrical combination for the purpose of preventing inundation of the highway.

H.06 Minor Defects

Minor defects are those which can be corrected with little or no risk of structure collapse or rendering of damage to adjacent or related members while making repairs or replacements.

Listed here are some examples of this class of defect:

(A) Damaged or misplaced clearance markers.

(B) Damaged or missing advisory and warning signs (Speed and/or Weight Limit, Vertical Clearance, Narrow Bridge, One Lane Bridge, One Lane Bridge for Trucks and Buses).

(C) Scaled or deteriorated paint on timber railings and curbs.

(D) Damaged or deteriorated railings and curbs.

(E) Uneven or cracked approach and deck surfacing.

(F) Broken or loose timber decking.

(G) Broken timber stringers.

(H) Ineffective supplemental bents.

(I) Accumulated drift adjacent to bents and piers.

(J) Minor erosions.

(K) Accumulated dirt or debris on decks, near stringer ends at supports, adjacent to bearings, and on chords of trusses.

(L) Plugged drains.

(M) Settlement or roughness of approach.

(N) Fire hazards.

(0) Faulty electrical contacts.

H.07 Major Defects

Some defects are considered major because they involve individual members, which effect structural stability of an entire span thus requiring underpinning of the span or supplementing of the member before removal. Others are included in this group because the cause of the defect and thus the measures needed to correct the defect, are numerous and varied requiring structural or other technical advice or the defect may cause equipment failure. Examples of this type of defect follow:

(A) Bent or damaged steel beams, girders, or truss members.

(B) Cracked or spalled concrete members, other than curb and railing.

(D) Crushed or decayed timber stringers, caps, posts or piles.

(E) Broken or weakened chord members of failed truss joints.

(F) Unusual looseness, or vibration of truss members.

(G) Loosened or decayed timber deck over an extended area.

(H) Defective bearings on substructure or in deck at expansion joints.

(I) Settled bents or piers.

(J) Major erosion or scour.

(K) Lack of paint on steel members, other than curb and railing.

(L) Extensive fire damage.

(M) Poor alignment or balance of movable bridge spans.

(N) Excessive noise, or vibration from operating machinery.

(0) Lack of lubricant in machinery bearings.

(P) Loose bolts.

H.08 Repair Materials and Procedures

When making repairs of defects whether minor or major, all work shall conform as closely as practicable with requirements, of the current Standard Specifications. Emergency and temporary work shall be planned to best meet the situation and protect traffic. Wherever applicable in all work, materials and procedures listed in this Section H.08 should be used unless variation from these is so stated in recommendation in the reports by the OSM&I or upon approval of the variation by the Bridge Maintenance Engineer.

H.08.1 Epoxy for Patching, Bonding, and Filling Voids in Concrete

Epoxy is a two component mixture that will adhere to most clean hard substances such as steel and concrete. When cured, it forms a strong material that can be used in certain structural repairs.

Epoxy can be pumped into cracks in concrete to re-bond the separated pieces, pumped into voids in concrete such as rock pockets or spaces between steel expansion dams and concrete deck, and used as bonding agent between original concrete and new concrete or mortar. It is also used as cement in place of Portland cement and water in mortar for patching or replacing concrete such as grout pads.

Two-component epoxy shall be carefully proportioned in accordance with directions on the container. The two components shall be mixed thoroughly before using and placed immediately after mixing.

Pot life of the mixed epoxy varies with the temperature of the material. When confined, the heat produced by the chemical reaction is not dissipated from the mix so the epoxy becomes progressively warmer and the chemical reaction becomes progressively accelerated. In confined lots, the pot life may be only a few minutes. The time required to harden is increased many fold by spreading out the material so its heat from chemical reaction is conducted away. If the epoxy is frozen immediately after mixing, the chemical process can be virtually stopped. So, by artificial heating or cooling, the time of set can be sped up or slowed down as is desired.

For proper final cure, the temperature of the epoxy should be a minimum of 65ºF (59.4º Celsius) for several hours. When heating to accelerate the curing, a direct flame should not be applied to the epoxy surface. A 1 inch (25.4 millimeters) cover of sand, or a steel plate supported to clear the epoxy surface by 1 inch (25.4 millimeters) or more, makes an effective protector from the flame. Either conducts the heat effectively to the epoxy. Never heat the epoxy to the boiling point or flame point.

To pump epoxy into cracks or voids, use a grease gun with Alemite fittings. If the void is behind a steel plate, a hole can be drilled through, of the proper diameter to receive a drive fit Alemite fitting. Cracks in concrete, or voids to be filled, can be pumped by inserting ½inch (12.7 millimeters) pipes held in with epoxy or PC grout or may be driven into a closely sized drilled hole in sound concrete, and fitted with an Alemite nipple at the exposed end. Open cracks to be pumped must be sealed along edges in advance of pumping, with an epoxy containing a thixotropic agent to prevent flowing away before setting.

Epoxy mortar can be produced by adding sand and gravel to the previously mixed two component epoxy. For large batches, this can be done most satisfactorily by adding the aggregates slowly to the mix in a clean bucket while stirring with a mechanical mixer such as a 3/8 inch (9.525 millimeters) rod bent to a "D" end and turned with an electric or air operated drill. Aggregates can be added until a satisfactory mix is obtained. Proportions between 4 and 10 parts of aggregate to I part of epoxy have been used for grout pads under masonry plates and patches in concrete.

Any tools or equipment used with epoxies must be cleaned before the epoxy has set (the sooner the easier) or it will be impossible to wash the epoxy off. Toluene, methylethylketone, or lacquer thinner, maybe used to clean tools. Use caution with these materials, as they are flammable and can be hazardous to health. Be sure to follow all label instructions.

The ingredients in epoxy are toxic to humans and livestock if taken internally. Many people are allergic to contact with the ingredients. For these reasons, it is advisable to wear waterproof gloves when mixing and applying epoxy. Inexpensive polyethylene gloves can be discarded after use. They can be obtained from Material Operations. Use soap, and water to remove the ingredients from the skin.

The two epoxy components can be stored in sealed individual containers for several years without detrimental effect. If stored for several months or more, the contents of each container must be stirred thoroughly before proportioning the mix.

Epoxies suitable for the above uses can be obtained from Material Operations.

H.08.2 Portland Cement Concrete and Steel Reinforcement

Concrete shall be placed with vibrators in all-important work. Aggregates shall be clean and well graded. No more water shall be used than is necessary to provide a workable mix. Reinforcing steel shall be placed as shown on plans and securely held in position when placing concrete. Forms shall be constructed adequately to prevent leaks and to hold in proper line and grade while placing and curing the concrete.

During the last few years there has been a large number of changes in concrete patching technology. The number of products available for patching purposes is too voluminous to mention here.

There is a sheet entitled Patching Materials available which lists the products by trade name, discusses characteristics and the do's and don'ts. This sheet is available from the OSM&L Copies of this sheet have been given to all District Maintenance Engineers.

There is a co-polymer called High Molecular Weight Methacrylate (HMWM). This product is especially good for filling cracks in concrete and knitting the concrete together. Special precautions are required when using it. Refer to "Code of Safe Operating Practice - Bridge and Highway Concrete Repairs Using HMWM Resins."

The following table gives approximate quantities of materials needed to produce one cubic yard (0.7646 cubic meters) of each of several classes of Portland cement concrete. These mixes produce a mix with about a four-inch (101.6 millimeters) slump if the aggregates are well graded. Adjustments must be made to produce a workable mix with proper yield.

	Cement Sacks = Pounds (Kilograms)	Combines Aggregates Pounds = Cubic Yards (loose measure)	Water Pounds = Gallons (Kilograms = Liters)
"A"	6 = 564 (255.8 kg)	3200 (1451.5 kg) = 0.99	290 (131.5 kg) = 35 (132.4 1)
"B"	5 = 470 (213.1 kg)	3320 (1505.9 kg) = 1.03	290 (131.5 kg) = 35 (132.4 1)
"C"	4 = 376 (170.5 kg)	3440 (1560.3 kg) = 1.06	267 (121.1 kg) = 32 (121.1 1)
"D"	7 = 658 (298.4 kg)	3150 (1428.8 kg) = 0.97	290 (131.5 kg) = 35 (132.4 1)

Mortar for patching, etc., can be composed of well-graded sand and cement in the following approximate proportions measured by volume:

Cement.	1 Part
Sand	3 Parts
Water	Sufficient to make a stiff mix

Additives should not be used without approval of the Bridge Maintenance Engineer.

Steel reinforcing bar sizes must comply with ASTM Standard Specifications. The bar numbers are based on the nearest number of 1/8 inches (3.175 millimeters) included in the nominal diameter of the bar. The weights have been adopted as standards. Bar number 2 is produced in plain rounds only. Bars numbered 9, 10 and 11 are round bars and equivalent in weight and nominal cross sectional area to the old type 1 inch (25.4 millimeters), 1 1/8 inches (28.575 millimeters) and 1 ¼ inches (31.75 millimeters) square bars. Bars numbered 14 and 18 are also round and as shown are equivalent to the old 1½ inches (38.1 millimeters) and 2 inch (50.8 millimeters) square bars.

The new reinforcing steel bars have more lugs per linear foot than on the old ones.

When joining new concrete to old, chip or saw ½ inch (12.7 millimeters) or deeper, along edges of concrete to be repaired to eliminate feather edges and produce neat, approximately straight line joints. Chip away all loose fragments. Remove all foreign material and rust from concrete and steel by sandblasting or wire brushing. Apply two-component epoxy bond to entire surface to be repaired. See Section H.08.1. Then, place mortar or concrete to replace all missing concrete.

Color of new mortar or concrete shall be made to match original concrete when it is cured. This usually can be accomplished by preparing a combination of 1/3 white cement and 2/3 normal cement for use in making the concrete or mortar. The proportion of white cement should be varied as required.

Strike off and finish of patches shall be done with wood or stone floats only. Steel floats impart a dark color to the surface.

All concrete or mortar shall be cured by keeping damp with water for 7 days or by coating with an approved colorless impervious membrane.

If great inconveniences to traffic result from necessary interruptions during repair and curing procedures or if justified by economics, special cement products with fast setting high early strength properties may be used. The type shall be as recommended by the Area Bridge Maintenance Engineer.

H.08.3 Steel

Steel members in structures, shall be repaired by replacing all or part, straightening, welding tears, and welding or bolting scabs over defects.

Heat can be of great assistance in straightening members if strategically applied but shall not be used without the approval of the Bridge Maintenance Engineer. When such approval is given, the member must be relieved of all dead and live load before heating.

Only common mild "carbon" steel members shall be heated. The maximum temperature shall not exceed 1300º F (2282.4º Celsius). At that temperature common mild carbon steels are reduced in yield point and ultimate strengths to about 10 percent of their values at 100 º F (122.4º Celsius) . When cooled off they return to approximately original strength and characteristics. Some of the high strength steels are decidedly changed by such heat cycles.

High strength bolts of the same diameter as the rivets removed shall be used to replace rivets in re-assembly. These bolts may be satisfactorily tightened by properly using pre-painted load indicating washers.

All welding shall be done by a certified welder.

H.08.4 Timber

Timber members in structures shall be repaired by replacing or supplementing.

H.08.5 Deck Surfacing

Surfacing for bridge decks shall be asphalt concrete unless specified otherwise. Because it places additional load on the bridge, surfacing shall not be placed on decks without prior, written approval from OSM&I. Additional surfacing obscures developing deck problems such as cracking and delamination. It also constrains preventive maintenance without complete removal of the blanket. When surfacing highway approaches to a bridge, taper the new surfacing down to a smooth junction with the deck grade at the paving notches.

On timber decks and thin plate steel decks, the asphalt binder, grading of aggregates, and proportionings must be adjusted to produce a mix which will adhere well to the deck, be relatively impervious, flexible, and have a skid resistant surface. Usually this can be achieved with an open graded mix placed over a heavy asphalt seal application on the deck.

On concrete decks the asphalt concrete is usually not subjected to as great a deflection per span as in timber so does not need to be as flexible. Imperviousness, good bond to the deck, and skid resistant qualities are essential.

The asphalts to be used in the surfacing and mix proportioning for either deck type are, influenced by climatic temperature ranges, traffic usage and many other factors.

The surfacing shall be placed by conventional methods and adjusted to produce a smooth riding surface free of low or high spots with the qualities specified above for the particular bridge type.

H.09 Repair and Reconstruction

H.09.1 Timber Stringers

H.09.2 In Reconstruction

Salvaged stringers, if in good condition and of the proper size, may be reused. Tops of stringers shall be lined up to a true plane and placed with the same edge up as when formerly used. Stringers shall be cut to a length not exceeding the distance center to center of caps or floor beams by more than 1 foot (0.3048 meters). The length shall be sufficient to provide at least 6 inches (152.4 millimeters) bearing at each end. When using new stringers, it is necessary to inspect for knots and to place stringers so that the greatest volume of knots, are in the upper third.

If knots are in the middle third, they must be placed with the greatest volume above the centerline.

H.09.3 In Existing Bridge as Supplement or Replacement

A stringer to be placed in an existing span shall be of the same depth and of equal width as other stringers in the panel, when the replacement stringer is of the same kind of material as the existing stringer. When Douglas Fir (DF) stringers are used to replace or supplement Redwood (RW) stringers, the DF stringer should have the same depth but may have two-thirds of the width of the RW stringer. In case of an emergency, the best available sizes may be temporarily used.

It is acceptable to keep bridging in place and to set additional pieces as necessary. See Chapter C5 for cuts required and method to use when installing a supplemental stringer or replacing an existing one.

No attempt shall be made to fit stringers to deck sag by use of an adz. The end wedges must be set to bring the stringer to same degree of tightness against deck at the center of span, as adjacent stringers. As the new stringer acquires sag and fits into place, wedges should be tightened. Wedges should always be secured in place with double-headed nails.

The portion of each upper edge of each stringer that extends beyond the center of bent shall be tapered down so it does not contact the bottom of deck. This is to prevent the deck from being pushed up over supports when the stringer is deflected under live loads.

If shims or wedges are necessary under stringers, they shall be substantial and of either Douglas fir or redwood and shall be tacked with double headed nails when set. Shingles are acceptable for the purpose.

See Section H.09.6 for size and spacing of stringers for various spans as applicable for temporary construction.

H.09.4 Supplemental Bent

When an emergency occurs, requiring immediate installation of a supplemental bent, approval by the OSM&I must be obtained in all cases.

In constructing and maintaining a supplemental bent, shims may be used as required so that all stringers bear on the cap. Shims placed under posts shall be full width of the post plus 1 inch. (25.4 millimeters). A series of thin shims should never be stacked. A block or plate plus two shims or just two wedges should be used. Shims or wedges must be nailed with double-headed nails.

When a supplemental bent washes out it shall be replaced immediately, if possible, or the bridge posted for restricted load until strengthened.

H.09.5 Bridge Rail

Concrete railing usually will require recasting of the damaged sections with new concrete. Occasionally, portions not seriously damaged can be patched with Portland cement mortar or realigned and adhered together with epoxy.

Steel railing frequently is so extensively damaged that replacement of panels is more economical than straightening or replacing miscellaneous pieces. When a panel of prefabricated railing is to be replaced, it is expedient to purchase it from the original fabricator because he is the only one who has the shop drawing available and therefore is in position to make a quick delivery.

When it is necessary to place a substantial, temporary, replacement for damaged concrete or metal railings, the OSM&I will furnish approved details.

Timber rail and wheel guards have many variations and designs. When small portions of any substantial type are damaged, it shall be replaced in kind. If all or practically all of any timber rail and wheel guard must be replaced, the entire rail and wheel guard shall be replaced as necessary to convert it all to the standard shown on page H-18, or all shall be replaced with a metal beam rail, subject to approval by the OSM&I.

H.09.6 Temporary Bridge

In the event an existing bridge washes out or is destroyed by some other means, the OSM&I shall be notified. That Office will furnish plans and/or advice for immediate replacement on emergency or permanent basis.

Detailed information for construction of several types of emergency timber bridges is provided on pages 22-24. Types shown utilize the most commonly found construction materials. When such a structure is necessary, the OSM&I will decide the appropriate type to be built based on materials available, obstacle to be crossed, conditions at the site and other related factors.

H.10 Miscellaneous

H.10.1 Preventive Maintenance

Maintenance forces shall take necessary precautions and perform various acts of maintenance that will prevent conditions that could contribute to the defects listed in Sections H.06 and H.07.

H.10.2 Mark High Water

A record of the highest high water mark for major streams shall be indicated by painting a white line 1 inch (25.4 millimeters) wide and 18 inches (457.2 millimeters) long, together with the date, on any convenient abutment, pier or column.

Records shall also be made of abnormally high water, unusual flow conditions and any other peculiar conditions during high water periods, which tend to cause scour of the streambed or bank and any alteration of the channel.

H.10.3 Approach Surfacing

When resurfacing the highway approaches to a bridge, the new surfacing should be tapered down to a smooth junction with the deck grade at the paving notches.

H.10.4 Bridge Numbers, Names, and Date Built

The bridge number and name assigned to each bridge by the OSM&I and the year it was built, shall be plainly stenciled on each structure in a position visible to traffic. Name signs are to be installed at bridges where structure or stream is of sufficient size or importance to justify publicizing its name. Installation of this sign shall conform to requirements of the Traffic Manual and approval of the Traffic Operations Program. Typical name types are shown in Section H.02.

Locations at which names, numbers and dates should be painted are depicted in the sketches on page H-26. The lettering should be about 2 inches (50.8 millimeters) high and in black or white to contrast with the background provided by the structure. Backgrounds should not be painted for purposes of enhancing the lettering.

H.10.5 Vertical Clearance

Every structure over a State highway having a vertical clearance of less than 15 feet (4.572 meters) shall have the clearance height indicated by a sign. The standard sign (W34C) adopted for this purpose is 120 inches (3.048 meters) x l8inches (457.2 millimeters), with 6 inch (152.4 millimeters) black letters and 8 inch (203.2 millimeters) numerals on a yellow reflecting background. (See Section M4.) When a sign of this length cannot be installed on a structure, a two line sign, 96 inch (2.438.4 meters) x 30 inch (.762 meters), carrying the same message may be used. These signs shall be placed on each side of the structure, facing approaching traffic, over the lane having the minimum clearance. The clearance height shall not be indicated on those structures having a clearance of 15 feet (4.572 meters) or greater. Existing black on white signs shall not be replaced unless replacement is required for other purposes.

On those structures where the vertical clearance has been painted, signs shall be erected when the painted message requires renewing. When the clearance has been painted on a structure having a vertical clearance of 15 feet (4.572 meters) or greater, the painting shall be allowed to wear out without being renewed.

The Vehicle Code limits the height of any load upon a vehicle to 14 feet (4.2672 meters), except that mobile homes may be 15 feet (4.572 meters) when traveling under a transportation permit. Those structures where the vertical clearance is less than 14 feet (4.2672 meters) shall have the clearance indicated by the W34 sign. An additional W34 sign with a W34A LOW CLEARANCE plate shall be placed 250 feet to 750 feet (76.2 to 228.6 meters) in advance of the structure.

The W34 sign may be used with the W34B -- MILES AHEAD plate well in advance of the structure at a point where the affected driver may select an alternate route or turn around. State highway structures over city streets or county roads having a vertical clearance of less than 15 feet (4.572 meters) may be signed as outlined above when deemed necessary by the Area Bridge Maintenance Engineer or the District Chief, Maintenance Branch.

The OSM&I shall be notified prior to placing any additional surfacing under a bridge. When additional surfacing is placed, the District permits section should be notified of the change in vertical clearance. At overcrossings and underpasses, the new surfacing can be feathered out to meet existing surfacing grade a short distance in advance of the structure spanning over the highway.

H.10.6 Weight and Speed Restrictions

In order to safeguard the traveling public and the structure, the Department has authority, under Section 124 of the Streets and Highways Code, to restrict the use of, or close a bridge considered in imminent danger of failure under legal loads. In such cases, weight limit signs of cloth shall be posted immediately, showing the safe weight limit for the structure. These temporary signs are available from Material Operations. Each district shall have a small supply on hand for immediate use should they be required.

Permanent limit restrictions are established by order of the Department of Transportation, following an engineering investigation and public hearing as prescribed in Sections 35750, 35751 and 35752 of the Vehicle Code.

The investigation is conducted by the OSM&I. The hearing is held by an appointee of the Director, usually an employee of the OSM&I.

These laws require a notice of the hearing be posted upon the bridge at least five days before the date of hearing. This shall be done by placing copies of the formal "Notice of Hearing" attached to plywood boards, at both ends of the structure in locations visible to traffic. One copy of the formal notice, showing time and date of posting and signed by the person erecting the notice, shall be returned to Headquarters Office.

The restrictions ordered by the Director are effective and binding upon the public only after signs stating the limitations are erected, and enforceable only while such signs are in place.

H.10.7 Safety Measures

For detail as to guardrail, clearance markers and warning and regulatory signs applicable to bridges, see Chapter M4.

H.10.8 Fire Protection

Suitable fire extinguishers shall be installed in each control room and machinery room of each drawbridge. In drawbridges where electricity is the prime source of power, only Dry Chemical or Carbon Dioxide extinguishers shall be installed.

H.10.9 Electrical Equipment

Repair or adjustment, of electrical equipment, shall be done by qualified personnel only.

Permanent changes in the circuitry of drawbridges shall not be done without consulting the OSM&I. This is not intended to prevent electricians from making necessary emergency connections.

H.10.10 Lubrication

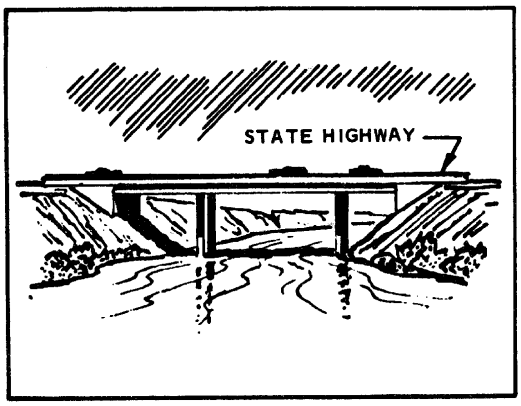
Standard items of manufacture such as electric motors, engines, compressors, gear reducers and pillow blocks incorporating sealed ball or roller bearings are usually furnished with maintenance manuals, which include recommended lubrication practices. These manuals shall be made a part of the Maintenance Manual in the control room and the recommended lubrication practices shall be followed exactly unless overruled by "Specific Lubrication Instructions".

Lubrication of open gears, wire ropes and sleeve bearings must be varied to meet the conditions under which they operate. Open gears seldom used and subject to accumulation of sand or dirt will be better protected and get less wear by painting with State Specification 8010-61J-45 paint and leaving all oil or grease off the teeth. Due to the great variation in proper lubrication requirements of somewhat similar facilities, the proper practice for each drawbridge will be covered in Specific Lubrication Instructions.
The manufacturer's manual and the Specific Lubrication Instructions for each bridge shall be made a part of the Special or Supplemental Orders included in data posted in each control room.

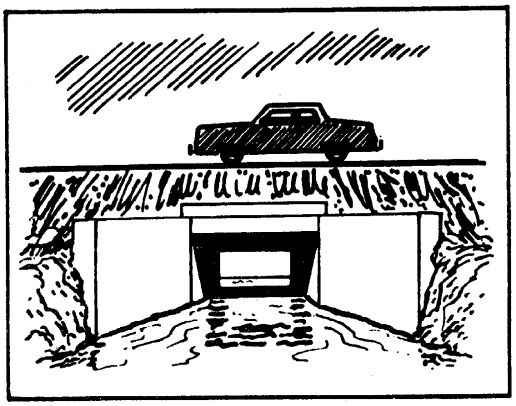
H.10.11 Overhead and Changeable Message signs

Inspecting and maintenance of these signs is covered in Chapter M4 of this Manual. In general, the OSM&I is responsible for detailed inspections and reports.

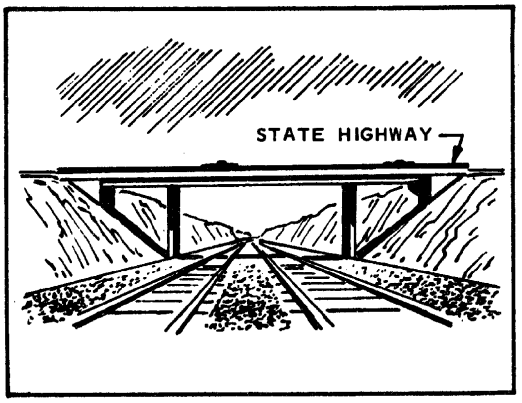
BRIDGES



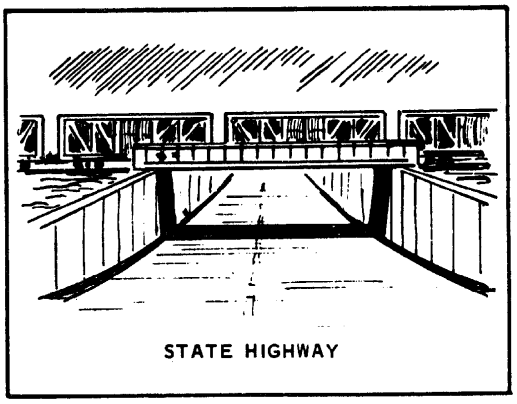
BRIDGE



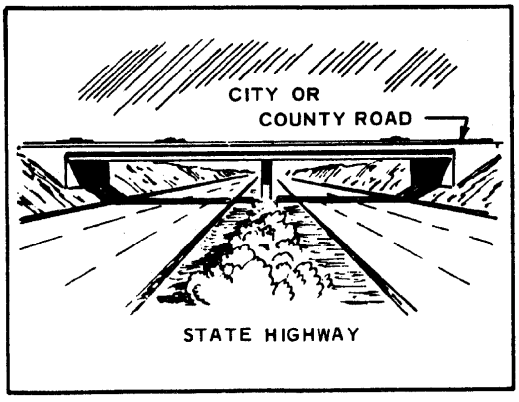
BRIDGE



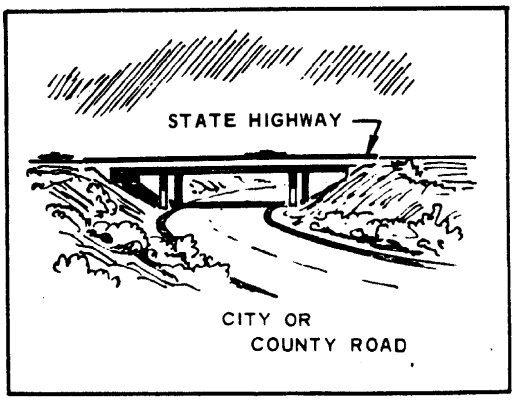
OVERHEAD



UNDERPASS

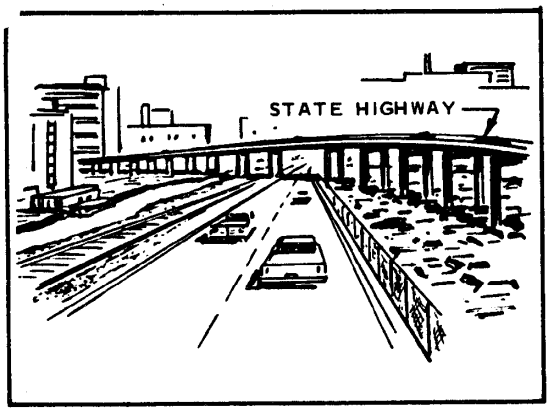


OVERCROSSING



UNDERCROSSING

BRIDGES



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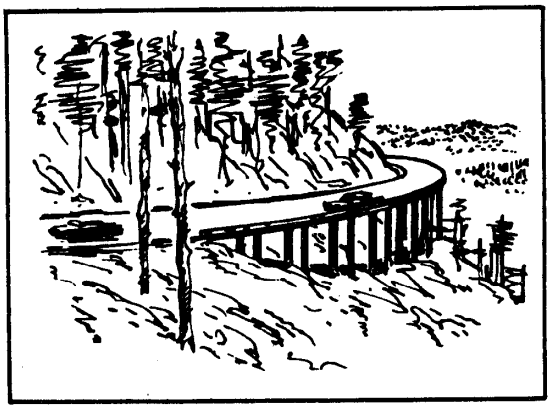

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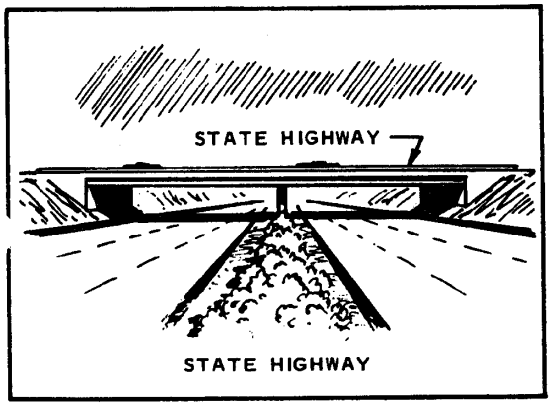
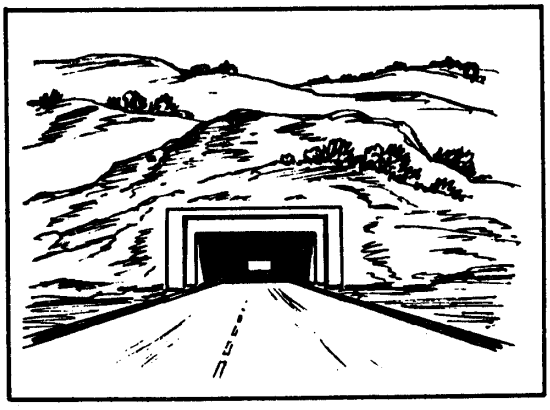
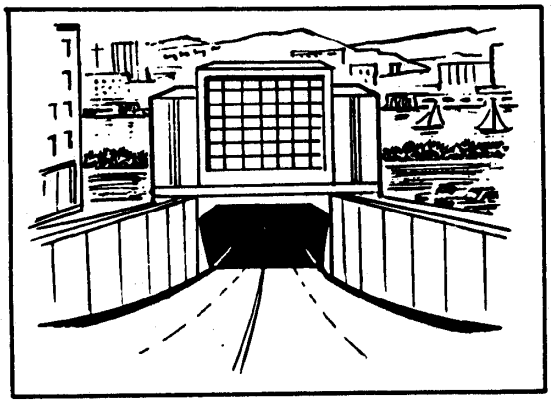


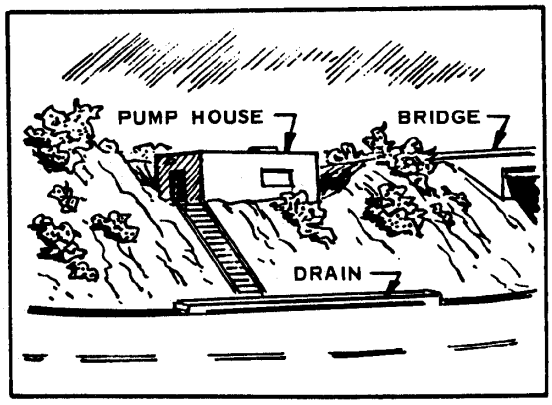
SEPARATION



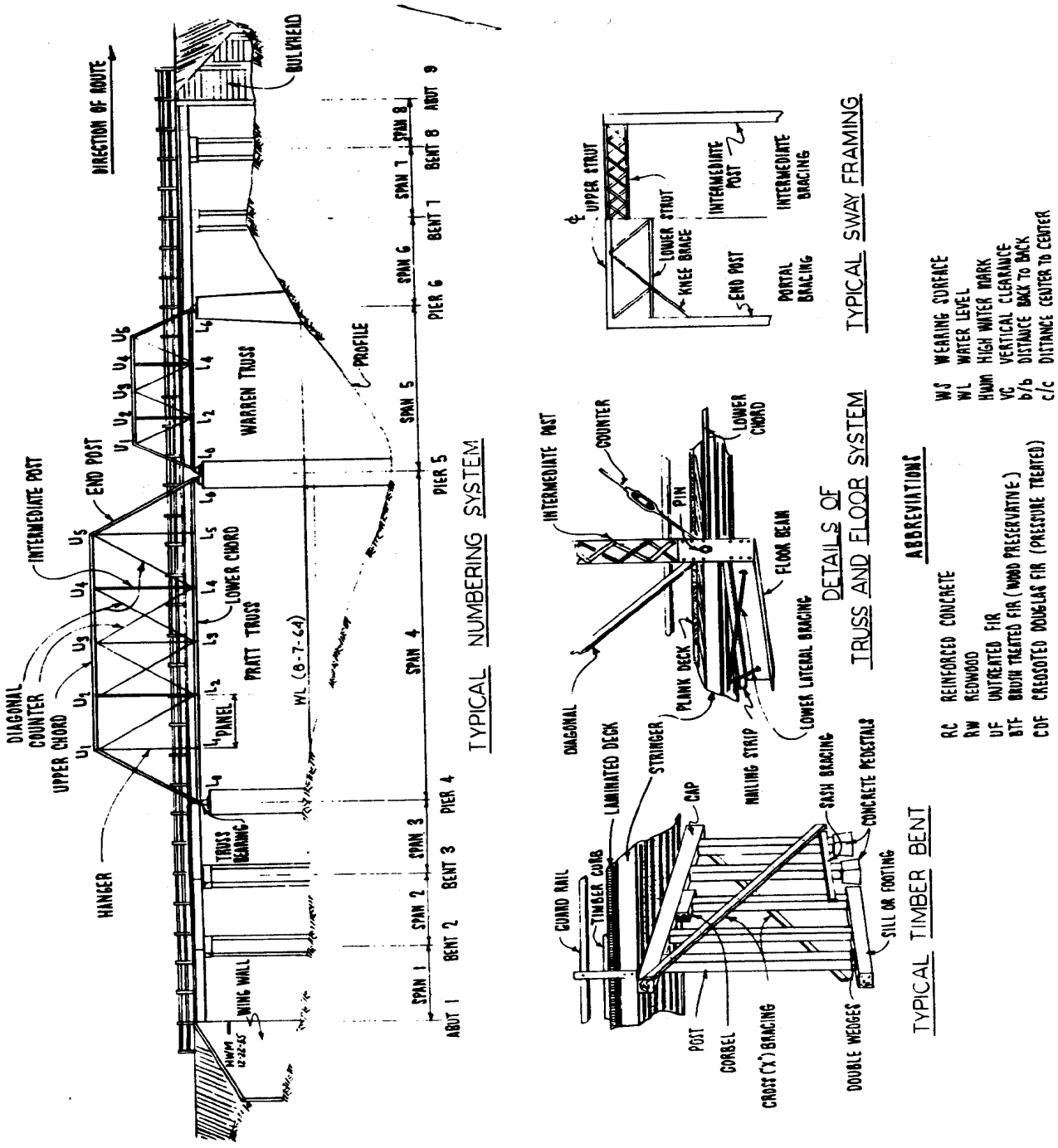
TUNNEL



TUBE



PUMP

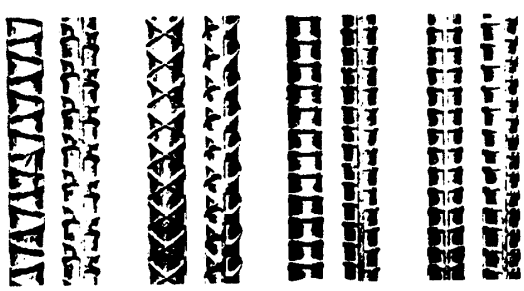

DIRECTION OF ROUTE
BULKHEAD
INTERMEDIATE POST
END POST
DIAGONAL
COUNTER
UPPER CHORD
HANGER
PANEL
PRATT TRUSS
LOWER CHORD
WARREN TRUSS
PROFILE
WL (6-7-64)
TRUSS BEARING
WING WALL
ABUT 1
SPAN 1
BENT 2
SPAN 2
BENT 3
SPAN 3
PIER 4
SPAN 4
PIER 5
SPAN 5
PIER 6
SPAN 6
BENT 7
SPAN 7
BENT 8
SPAN 8
ABUT 9
TYPICAL NUMBERING SYSTEM
UPPER STRUT
KNEE BRACE
LOWER STRUT
INTERMEDIATE POST
END POST
PORTAL BRACING
INTERMEDIATE BRACING
TYPICAL SWAY FRAMING
INTERMEDIATE POST
COUNTER
PIN
LOWER CHORD
DIAGONAL
PLANK DECK
FLOOR BEAM
LOWER LATERAL BRACING
DETAILS OF TRUSS AND FLOOR SYSTEM
GUARD RAIL
TIMBER CURB
LAMINATED DECK
STRINGER
CAP
RAILING STRIP
SASH BRACING
CONCRETE PEDESTALS
SILL OR FOOTING
POST
CORBEL
CROSS ('X') BRACING
DOUBLE WEDGES
TYPICAL TIMBER BENT
ABBREVIATIONS
RC REINFORCED CONCRETE
RW REDWOOD
UF UNTREATED FIR
BTF BROWN TREATED FIR (WOOD PRESERVATIVE)
DFF CREOSOTED DOUGLAS FIR (PRESSURE TREATED)
WS WEARING SURFACE
WL WATER LEVEL
HWM HIGH WATER MARK
VC VERTICAL CLEARANCE
b/b DISTANCE BACK TO BACK
c/c DISTANCE CENTER TO CENTER

BRIDGES

REINFORCING STEEL BAR SIZES AND DIMENSIONS

REINFORCING STEEL					
STANDARD A305 REINFORCING BARS					
BAR SIZES		WEIGHT	NOMINAL DIMENSIONS — ROUND SECTIONS		
OLD (INCHES)	NEW (NUMBERS)	POUNDS PER FOOT	DIAMETER INCHES	CROSS SECTIONAL AREA - SQ. INCHES	PERIMETER INCHES
1/4	2	.167	.250	.05	.786
3/8	3	.376	.375	.11	1.178
1/2	4	.668	.500	.20	1.571
5/8	5	1.043	.625	.31	1.963
3/4	6	1.502	.750	.44	2.356
7/8	7	2.044	.875	.60	2.749
1	8	2.670	1.000	.79	3.142
1	9	3.400	1.128	1.00	3.544
1 1/8	10	4.303	1.270	1.27	3.990
1 1/4	11	5.313	1.410	1.56	4.430
	14	7.650	1.692	2.25	5.316
	18	13.600	2.256	4.00	7.088

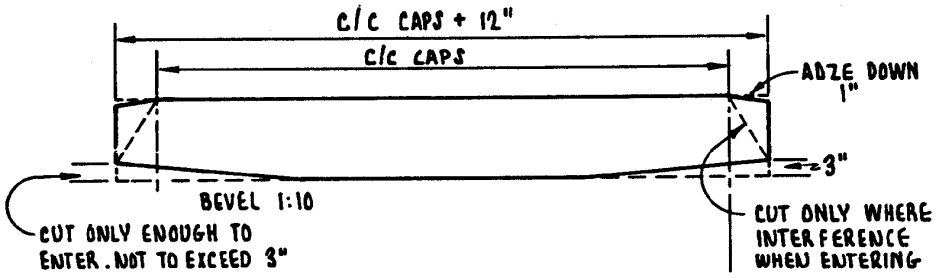
New Type Deformed Bars



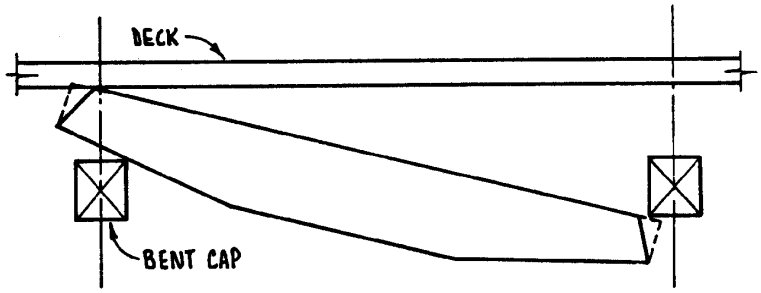
Old Type Deformed Bars

BRIDGES

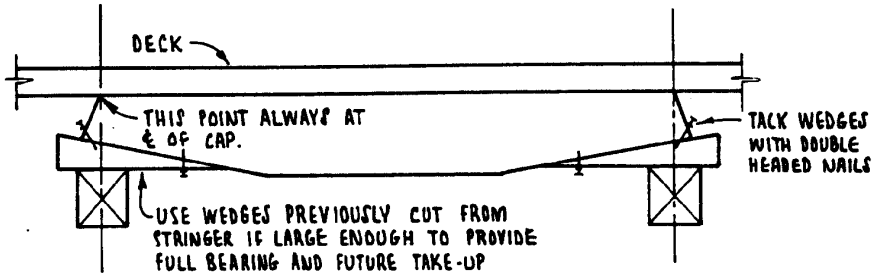
METHOD OF REPLACING EXISTING STRINGERS



CUTS TO BE MADE

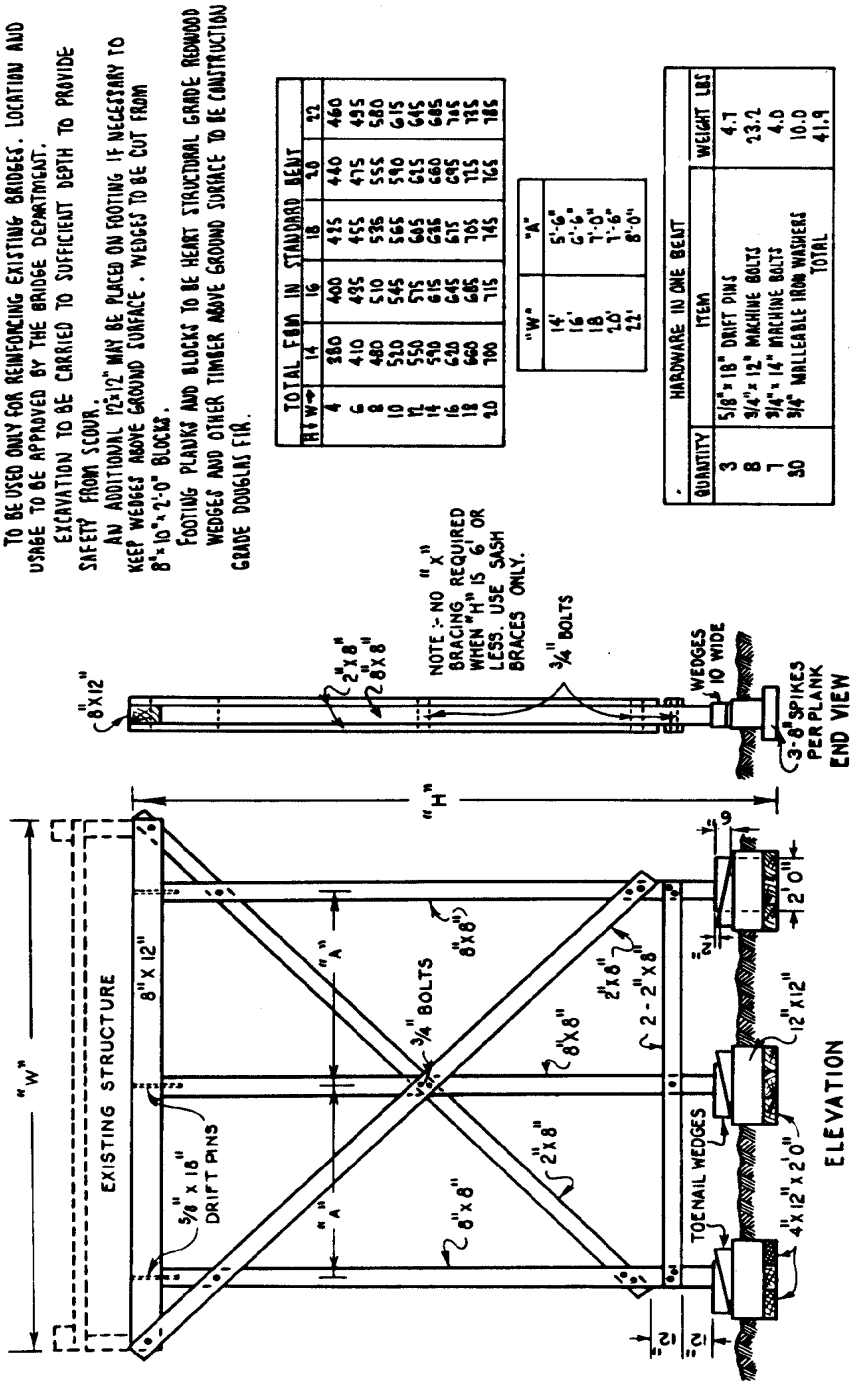


ENTERING STRINGER

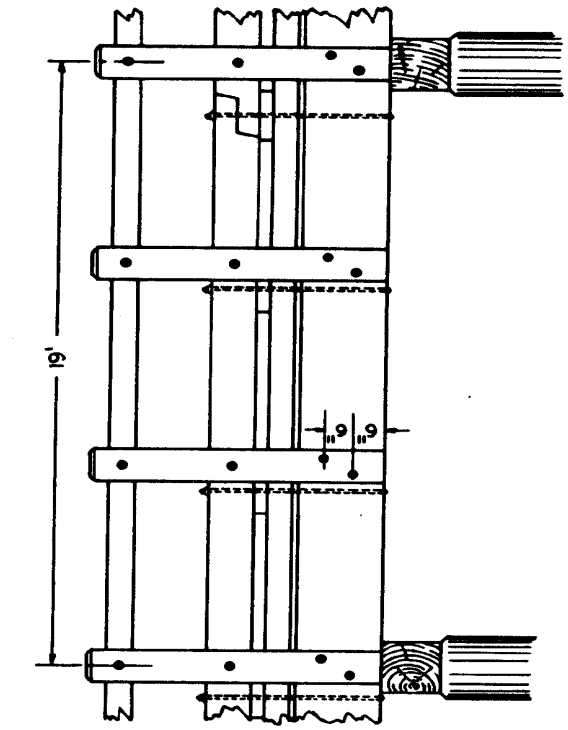


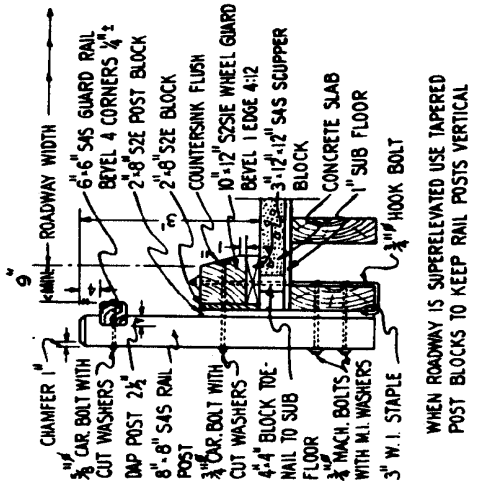
WEDGED IN PLACE

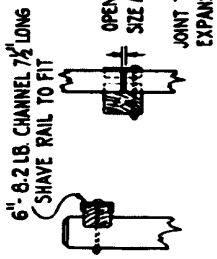
DETAIL OF SUPPLEMENTAL TIMBER BENT



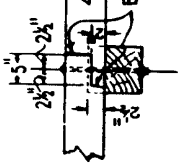
STANDARD TIMBER GUARD RAIL AND WHEEL GUARD





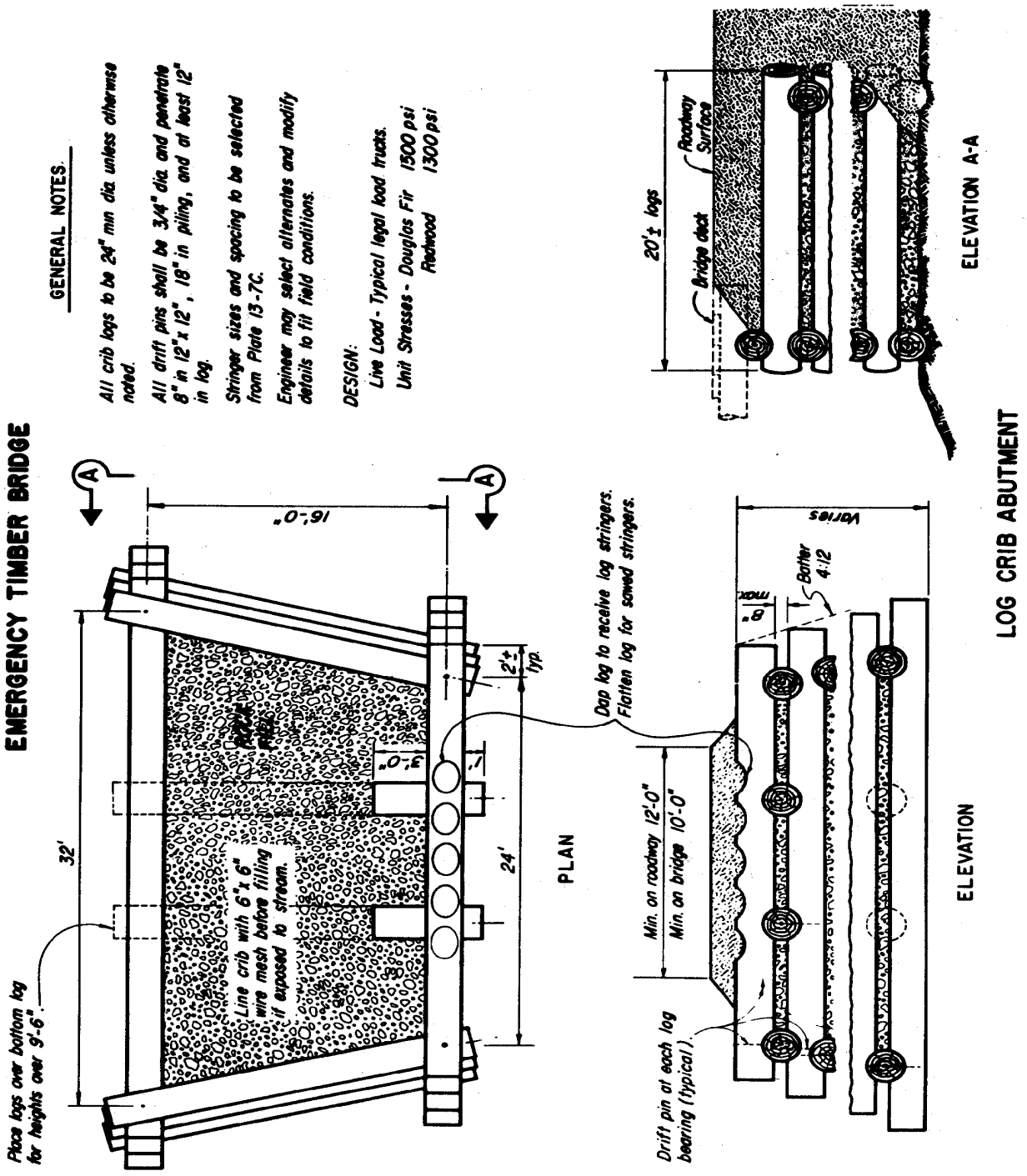


GUARD RAIL EXPANSION JOINT



GUARD RAIL SPLICE

NOTE : ALL HARDWARE TO BE GALVANIZED
ALL TIMBER TO BE HEART STRUCTURAL GRADE REDWOOD.


EMERGENCY TIMBER BRIDGE
GENERAL NOTES.
All crib logs to be 24" min dia. unless otherwise noted.
All drift pins shall be 3/4" dia. and penetrate 8" in 12"x 12", 18" in piling, and at least 12" in log.
Stringer sizes and spacing to be selected from Plate 13-7C.
Engineer may select alternates and modify details to fit field conditions.
DESIGN:
Live Load - Typical legal load trucks.
Unit Stresses - Douglas Fir 1500 psi
Redwood 1300 psi
Line crib with 6"x 6" wire mesh before filling if exposed to stream.
Place logs over bottom log for heights over 9'-6".
32'
16'-0"
2'± typ.
24'
PLAN
Dap log to receive log stringers. Flatten log for sawed stringers.
Min. on roadway 12'-0"
Min. on bridge 10'-0"
Drift pin at each log bearing (typical).
Varies
Batter 4:12
ELEVATION
20'± logs
Roadway Surface
Bridge deck
ELEVATION A-A
LOG CRIB ABUTMENT

BRIDGES

Size and Spacing of Stringers For Emergency Bridges

(Refer to Plate 13-7A, B for Construction Details)

SAWED STRINGERS WITH PLANK DECK

Span (ft.)	Size and Spacing (Inches)											
	Douglas Fir (1500 psi)											
	4 x 14	4 x 16	4 x 18	4 x 20	4 x 22	4 x 24	6 x 14	6 x 16	6 x 18	6 x 20	6 x 22	6 x 24
15	16	21	26	32	39	46	24	31	39	48	48	48
17	13	18	22	27	33	40	20	26	33	41	48	48
19	12	15	19	24	29	34	17	23	29	36	43	48
21	10	13	17	21	26	30	15	20	26	31	38	45
23	9	12	15	19	23	27	14	18	23	28	34	40
25	8	11	13	17	20	24	12	16	20	25	30	36
27	7	9	12	15	18	21	10	14	18	22	26	31
29	6	8	10	13	15	18	9	12	15	19	23	27
	Redwood (1300 psi)											
15	14	18	23	28	34	40	20	27	34	42	48	48
17	12	15	19	24	29	34	17	23	29	35	43	48
19	10	13	17	21	25	30	15	20	25	31	37	45
21	9	12	15	18	22	26	13	17	22	27	33	39
23	8	10	13	16	20	24	12	15	20	24	29	35
25	7	9	12	14	18	21	10	14	17	22	26	31
27	6	8	10	12	15	18	9	12	15	19	23	27
29	5	7	9	11	13	16	8	10	13	16	20	24

LOG STRINGERS WITH PLANK DECK

Span (ft.)	Diameter and Spacing (Inches)							Diameter and Spacing (Inches)						
	Douglas Fir (1500 psi)							Redwood (1300 psi)						
	14	18	22	26	30	36	42	14	18	22	26	30	36	42
15	32	48	48	48	48	48	48	27	48	48	48	48	48	48
17	27	48	48	48	48	48	48	23	48	48	48	48	48	48
19	24	48	48	48	48	48	48	20	43	48	48	48	48	48
21	21	44	48	48	48	48	48	18	38	48	48	48	48	48
23	18	39	48	48	48	48	48	15	33	48	48	48	48	48
25	16	35	48	48	48	48	48		30	48	48	48	48	48
27		30	48	48	48	48	48		26	47	48	48	48	48
30		24	45	48	48	48	48		21	38	48	48	48	48
35			33	48	48	48	48			28	48	48	48	48
40			26	44	48	48	48				37	48	48	48
45				35	48	48	48				29	46	48	48
50				28	45	48	48					37	48	48
55					37	48	48					30	48	48
60					31	48	48						46	48
65						48	48						39	48

LOG STRINGERS WITH EARTH FILL DECK

Span (ft.)	Douglas Fir (1500 psi)		Redwood (1300 psi)	
	Diam. (In.)	Min. No. For 10 ft. Rd. Width	Diam. (In.)	Min. No. For 10 ft. Rd. Width
15	14	10	14	10
17	14	10	14	10
19	14	10	14	10
21	14	10	16	9
23	16	9	16	9
25	16	9	16	9
27	16	9	18	8
30	18	8	20	7
35	20	7	24	6
40	24	6	26	6
45	26	6	28	6
50	28	6	30	5
55	30	5	34	5
60	34	5	36	4
65	36	4	38	4